NUMBER 27

Proceedings

of

The Canadian Phytopathological Society

Twenty-sixth Session

JUNE 20-23, 1960

ONTARIO AGRICULTURAL COLLEGE
GUELPH, ONTARIO

DEC - 5 1960

Editorial Committee
R. V. CLARK (Chairman)
J. A. PARMELEE
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The Canadian Phytopathological Society

LIST OF OFFICERS AND COUNCIL
1959-60

President

M. W. CORMACK, Research Laboratory, Canada Agriculture, Saskatoon, Sask.

Vive-President

W. E. SACKSTON, Prof. Plant Pathology, Macdonald College, Quebec.

Secretary-Treasurer

R. J. BAYLIS, Plant Research Institute, Research Branch, Canada Agriculture, Ottawa, Ontario.

Councillors

A. J. SKOLKO, Program Directorate, Research Branch, Canada Agriculture, Ottawa, Ontario.

H. GENEREUX, Research Station, Canada Agriculture, St. Anne de la Pocatiere, Que.

Copies of the Proceedings of the Canadian Phytopathological Society may be obtained from the Secretary-Treasurer, Dr. V. R. Wallen, Plant Research Institute, Research Branch, Canada Agriculture, Ottawa, Ontario.

The price of single copies is 50c.

ANNUAL MEETING June 20-23, 1960

C.P.S. Ontario Agricultural College, Guelph, Ontario

Row 1: **R. C. Russell, B. H. MacNeill, H. Sharan, R. J. Baylis, M. W. Cormack, W. E. Sackston, D. L. Bailey, Miss A. Wellman, W. G. Benerict, W. B. Moutain, J. S. Jhooty, J. Sabanayagam, J. P. MacKinnon, R. H. Estey, C. D. McKeen.**

Row 2: **A. J. Skolko, D. J. Samborski, P. M. Simmonds, A. A. Hildebrand, D. R. Sands, S. S. Husain, J. T. Slykhuis, P. K. Basu, L. T. Richardson, D. M. McLeod, D. W. Creelman, W. E. McKeen, R. C. Zimmer, L. Cinq-Mars, J. F. Hockey, W. G. Kemp, S. T. Fushtey, J. A. Clark.**

Row 3: **R. Stace-Smith, W. C. Broadfoot, R. G. Atkinson, W. A. Hodgson, T. R. Davidson, J. Bradbury, K. Bos, L. V. Busch, J. George.**

IN MEMORIUM

Since the appearance of the last number of the Proceedings, the Society has lost four charter members and one regular member. We mourn the passing of these Scientists; our Society would have benefited greatly by their knowledge and experiences for none reached, in years, the three score and ten which most of us expect to attain. We respectfully ask you to dwell a moment in thought, to recall that these men were once our associates — mentors — friends; that each has contributed in small or large measure to the advancement of Botanical Science and the amelioration of our Society.

OMER CARON. 1893 — 1959.

Graduate of Laval University, Quebec, Que. Botanist and Plant Pathologist with the Provincial Department of Agriculture, Quebec, Que. Mr. Caron held the presidency of both the Quebec Society for the Protection of Plants and of the Soc. de Linneene de Quebec.

JOHN LORNE HOWATT. 1898 — 1959.

Graduate of McGill University, Lecturer at the University of New Brunswick and Plant Pathologist with the Can. Dept. Agr., Research Station, Fredericton N.B. Mr. Howatt held Membership in the Potato Association of America and was a charter member of the Canadian Society of Microbiologists.

KENNETH WILLIAM NEATBY. 1900 — 1958

Graduate of the Universities of Saskatchewan and Minnesota. Geneticist, Plant Breeder, Phytopathologist, and Director Science Service, Can. Dept. Agr., he was slated to become Assistant Deputy Minister (Research) of the same department at the time of his death. Dr. Neatby was a member of many scientific societies in Canada and U.S.A. and had on more than one occasion received honorary doctorate degrees.

JAMES KEITH RICHARDSON. 1899 — 1960

Graduate of McGill University. Plant Pathologist with the Can. Dep. Agr., Plant Pathology Laboratory, St. Catharines, Ontario.

ANSON ROBERTSON WALKER. 1893 — 1959

Graduate of Queens and Toronto Universities. Plant Pathologist and Head of the Department of Botany, University of Western Ontario, London, Ont. Prof. Walker was a charter member of the Canadian Society of Microbiologists.

DONALD REDDICK. 1883 — 1955

Dr. Reddick graduated from Wabash College, Miss. and Cornell University, N.Y. His career as a plant pathologist began and ended at Cornell — in 1950 on his retirement he was made Emeritus Professor of Plant Pathology. His most widely known work is with diseases of beans and potatoes especially in the breeding of potatoes resistant to late blight.

A charter and honorary member of our Society, Dr. Reddick was also a charter member of the American Phytopathological Society and served the latter as Business Manager and editor of Phytopathology, and as councillor and president. He held membership in a number of other North American and European societies concerned with biology and was among those instrumental in bringing about the recognition in North America of Plant Pathology as a science.

It is indeed regrettable that Dr. Reddick's death was not recorded in earlier issues of the Proceedings of the Canadian Phytopathological Society, and we offer apology to the members for this omission.

MINUTES OF THE TWENTY-SIXTH MEETING HELD AT THE ONTARIO AGRICULTURAL COLLEGE, GUELPH, ONT. JUNE 20-23, 1960.

Business Sessions: June 20 and June 23.

The Society meetings and business sessions were held in the Biology Building. The president Dr. M. W. Cormack opened the sessions with an address of welcome to members and visitors.

The minutes of the twenty-fifth meeting were adopted as printed in the Proceedings Number 26 issued January, 1959.

The report of the Secretary-Treasurer was adopted on a motion by A. J. Skolko, seconded by L. V. Busch. Carried.

The report of the Editorial Committee was adopted on a motion by A. J. Skolko, seconded by R. S. Willison. Carried.

The report of the Nominating Committee was adopted on a motion by A. J. Skolko, seconded by D. J. Samborski. Carried.

The report of the Program and Publicity Committee was adopted on a motion by B. H. MacNeill, seconded by C. D. McKeen. Carried.

The report of the representative to the Canadian Society of Microbiologists was adopted as reported by J. J. Miller.

The report of the Terminology Committee was adopted on a motion by A. J. Skolko, seconded by W. C. Broadfoot. Carried. It was moved by W. E. Sackston and seconded by R. S. Willison that the review "Terminology in Plant Virus Diseases" when completed, be submitted for publication in the Canadian Journal of Botany with permission to have it reprinted in Phytopathology. Carried.

The report of the Resolution Committee was read by W. E. Sackston. The formal resolutions (Nos. 1-3) were endorsed by the meeting. After considerable discussion the remaining resolutions were passed as amended. These resolutions and amendments appear in the report of the Resolution Committee.

The meeting agreed that the members of the Nominating Committee be named from the Chair. On the recommendation of the Editorial Committee that it be reconstituted, R. J. Baylis moved and J. T. Slykhuis seconded that R. V. Clark, J. A. Parmelee and J. G. Shaw form the new committee. Carried.

M. W. Cormack expressed the appreciation of the Society to T. C. Vanterpool for his service as Science editor of the Canadian Journal of Plant Science. R. S. Willison will replace Prof. Vanterpool in this capacity.

It was proposed by A. J. Skolko, seconded by W. E. Sackston and unanimously approved that the following be elected Honorary Members of the Society: G. H. Berkeley, W. F. Hanna, D. J. MacLeod and Wm. Newton.

The following applications for membership in the Society were approved unanimously on a motion by L. T. Richardson, seconded by B. H. MacNeill: E. C. Reid, N. Colotelo, E. W B. Ward, H. K. Seth, M. J. Pratt, J. R. Van Diepen, N. Sharan, W. B. Mountain, Z. A. Patrick, R. M. Sayre, C. B. Kelly, J. A. Clark, C. H. Unwin, W. J. Crist, F. R. Forsyth, H. W. J. Ragetli, P. K. Basu and G. Fleischmann.

It was moved by R. J. Baylis and seconded by L. V. Busch that Honoraria for stenographic assistance be provided. Carried.

The desirability of meeting with the Canadian Society of Microbiology was discussed at some length. L. V. Busch moved and R. H. Estey seconded a motion that

the society do not meet with the Canadian Society of Microbiology. Carried. It was further moved by L. T. Richardson and seconded by R. H. Estey that since the Canadian Society of Microbiology is now fully established and with its own Proceedings, the Canadian Phytopathological Society need no longer maintain a representative to report on the progress of this Society. Carried.

The meeting was adjourned following the installation of the President-elect — W. E. Sackston.

COMMITTEES

Auditors: Mildred K. Nobles and J. W. Groves.

Editorial: R. V. Clark (Chairman), J. A. Parmelee, J. G. Shaw, V. R. Wallen.

Nominating: M. W. Cormack (Retiring President as Chairman), A. J. Skolko, M. F. Welsh, R. H. Estey, R. A. Ludwig.

Program and Publicity: R. J. Ledingham (Chairman), R. D. Whitney, V. R. Wallen.

Resolutions: W. E. Sackston (Chairman), K. A. Harrison.

Terminology: M. F. Welsh (Chairman), W. A. F. Hagborg, B. H. MacNeill, H. M. Good, T. C. Vanterpool, R. S. Willison, R.A. Ludwig, W. E. McKeen, C. D. McKeen, D. J. MacLeod, R. Pomerleau, L. E. Tyner, A. W. Henry, A. N. Langford.

Regional Representatives:

Maritimes	J. Munro
Eastern Quebec	D. Leblond
Western Quebec	F. Godbout
Eastern Ontario	R. J. Baylis
Western Ontario	B. H. MacNeill
Manitoba	W. J. Cherewick
Saskatchewan	R. D. Tinline
Alberta	E. J. Hawn
B. C. Mainland	R. Stace-Smith
Vancouver Island	R. E. Foster

REPORT OF THE SECRETARY-TREASURER

Mr. President and Fellow Members:

It is my pleasure to report as Secretary-Treasurer for the year ending May 31, 1960.

The twenty-fifth session of the Society was held at Acadia University, Nova Scotia June 23-26, 1958. The Proceedings were reported in Number 26 of the Society's publication issued January 1959.

The Society did not meet in general session during 1959. The Council however, held an annual meeting August 25, 1959 in Montreal at the time of the IX International Botanical Congress. Council at that time appointed me to replace R. L. Millar who resigned as Secretary-Treasurer after serving one year of his term of office. The President conveyed to Dr. Millar the council's appreciation of his service in behalf of the membership.

Membership of the Society totals 208. A slight decline since 1958 is noted as a result of several retirements and consequent resignations. These are however, more than offset by the 18 applications for membership to be approved.

The Society pays tribute to the passing of five members since our meeting in 1958. Prof. A. R. Walker, University Western Ontario; Dr. K. W. Neatby, Director, Science Service; Mr. J. L. Howatt, Fredericton; Mr. Omer Caron, Quebec; and Mr. J. K. Richardson, St. Catharines.

Our financial statement for the year just ended shows a larger than usual balance of $864.32. Obviously reflected is the absence of printing costs or expenses of an annual meeting which were deferred during 1959.

Respectfully submitted,

R. J. Baylis,

Secretary-Treasurer.

FINANCIAL STATEMENT

CANADIAN PHYTOPATHOLOGICAL SOCIETY

June 1, 1958 to May 31, 1959

Revenue :

Balance brought forward		$335.68
By fees	$413.00	
Bond interest	15.00	
Banquet tickets	78.00	
Sale of Proceedings	18.50	524.50
		$860.18

Expenditures :

Banquet — Wolfville, N.S.	100.75	
Printing of Proceedings No. 26	218.35	
Refund of fees (over-payments)	12.60	
Postage and Supplies	30.25	
Bank charges	3.80	365.75
Bank balance May 31, 1959		$494.43

Additional Assets :

Dominion of Canada Bond (Series P7Z95546)	$500.00

Audited and found correct,

(signed) Mildred K. Nobles

J. Walton Groves

FINANCIAL STATEMENT

CANADIAN PHYTOPATHOLOGICAL SOCIETY

June 1, 1959 to May 31, 1960

Revenue :

Balance brought forward			$494.43
By fees — Current '59-60	$290.00		
— Advance '60-61	49.00		
— Arrears	36.00		
		$375.00	
Bond interest		15.00	
Sale, proceedings		17.50	407.50
Total receipts			$901.93

Expenditures :

Honoraria — Stenographic assistance ('58-59)	15.00	
Postage and Supplies	20.00	
Bank charges	2.61	37.61
Bank balance May 31, 1960		$864.32

Additional Assets:

Dominion of Canada Bond (Series P7Z95546)	$500.00

Audited and found correct,

(signed) Mildred K. Nobles

J. Walton Groves

REPORT OF THE EDITORIAL COMMITTEE

The Proceedings of the twenty-fifth session of the Canadian Phytopathological Society covering the meetings held at Acadia University, Wolfville, Nova Scotia in June 1958 were issued January 5, 1959.

The Proceedings include abstracts of 15 papers presented at the meetings, together with a list of titles of 77 papers published by members of the Society during the period June 1, 1957 to May 31, 1958.

Because of resignations the committee will have to be reconstituted.

D. S. MacLachlan

V. R. Wallen (Acting Chairman)

REPORT OF THE NOMINATING COMMITTEE

The Nominating Committee of the Canadian Phytopathological Society is pleased to present the following unanimous nominations to office for the year 1960-61 :

President :	W. E. Sackston
Vice-President :	R. S. Willison
Secretary-Treasurer :	V. R. Wallen
Councillors :	M. W. Cormack
	A. N. Langford

Respectfully submitted

G. W. Ayers
R. E. Fitzpatrick
L. W. Koch
B. J. Sallans
A. J. Skolko (Chairman).

REPORT OF THE PROGRAM AND PUBLICITY COMMITTEE

The program committee consisting of L. V. Busch, R. J. Baylis and B. H. MacNeil was fortunate in being able to enlist the help of Dr. D. L. Bailey who took over the task of organizing a panel discussion on "Plant Pathology — Today and Tomorrow". For the most part details of arrangements were made by correspondence through the office of the Secretary.

Rooms 114 and 118 in the old Biology Building on the O.A.C. campus were reserved for our regular sessions and for a joint meeting with the Agricultural Pesticide and Technical Society. The program for the latter session was arranged in conjunction with Dr. Minshall, Secretary of the A.P.T.S.

After considerable debate, it was decided that the Annual Dinner would be held in the Cafeteria, Physical Education Building, O.A.C. Mr. Thor Hansen, Public Relations Department, British American Oil Company, was invited as Guest Speaker for the Occasion.

The Committee wishes to express its appreciation for the co-operation it received from the local Program Committee of the A.I.C.

B. H. MacNeill (Chairman)

REPORT OF THE REPRESENTATIVE TO THE CANADIAN SOCIETY OF MICROBIOLOGISTS

The Tenth Annual Meeting of the Canadian Society of Microbiologists was held at the University of British Columbia, Vancouver, June 13-19, 1960. The registration was 123, which included 24 from the United States. An invitation had been sent to the Northwestern Branch of the Society of American Bacteriologists.

Sixty-five papers were presented. Sufficient time for the presentation of the papers was made possible by running two concurrent sections, "Physiology" and "Medical Microbiology". A symposium by 4 speakers dealt with various aspects of Marine Microbiology.

The Society is in sound financial condition, having 429 paid-up members, an increase of 49 during the past year. We hope to reach the 500 mark by the end of 1960. A Manitoba Branch of the Society comprising about 40 members has now been established.

The President for 1960-61 is Dr. T. W. M. Cameron, and the Secretary-Treasurer is Dr. John Robinson. Dr. Norman James was elected to Honorary Membership.

The Society extended its thanks to Dr. R. G. E. Murray, who has served as Editor of the Canadian Journal of Microbiology since its establishment. He will be succeeded by Dr. F. E. Chase. Under Dr. Murray's guidance the Journal has become internationally recognized. The Journal is published quarterly with a total of about 700 pages annually; publication is reasonably prompt, and in addition to the membership there are about 1000 subscribers, mainly libraries. Papers are submitted from various parts of the world.

Preparations are well in hand for the Eighth International Microbiological Congress, to be held in Montreal in 1962. Local reservations have been made and Committees appointed. Principal topics being arranged are: Agricultural, Industrial, Medical, and Veterinary Microbiology, Form and Structure and Virology.

The question of affiliating with the Canadian Federation of Biological Societies was discussed. There is considerable variance of opinion in the Society concerning the advisability of such a move. A Committee is to be appointed by the new executive to study the matter and it will be considered again when they bring in their report.

The Eleventh Annual Meeting of the Society will be held in Kingston, Ontario, in June 1961.

Respectfully submitted,

J. J. Miller

REPORT OF THE TERMINOLOGY COMMITTEE

The 1958 revision of terms and definitions has yielded responses from 27 workers in Canada, the United States, the United Kingdom, and several European countries. There is now general agreement on most terms, and ample evidence of support from plant pathologists in these countries. However, a number of constructive suggestions were submitted, that will considerably improve the final revision. This revision is now being made, and the manuscript is being prepared for publication.

If necessary, the Committee chairman will rent a cabin in the hills for several days this summer, to gain the necessary undisturbed privacy for completion of the assignment.

The majority of Committee members consider that the Committee should be disbanded as soon as this terminology review has been published.

W. A. F. Hagborg
B. H. MacNeill
H. M. Good
T. C. Vanterpool
R. S. Willison
R. A. Ludwig
W. E. McKeen
C. D. McKeen
D. J. MacLeod
R. Pomerleau
L. E. Tyner
A. W. Henry
A. N. Langford
M. F. Welsh (Chairman)

REPORT OF THE RESOLUTIONS COMMITTEE

1. Whereas the Canadian Phytopathological Society has held its 26th session at the Ontario Agricultural College, Guelph, Ont., June 20-23, 1960, in conjunction

with the annual meeting and convention of the Agricultural Institute of Canada, and whereas the accommodations and facilities placed at the disposal of the Society have contributed notably to the success of the sessions :

Be it resolved that we extend our sincere appreciation to :

a) Our hosts the Guelph Branch of the Agricultural Institute of Canada for their hospitality.

b) The President of the Ontario Agricultural College, Dr. J. D. McLachlan, for the excellent facilities provided on this campus.

c) Drs. B. H. MacNeill and L. V. Busch for their arrangements for the program and banquet.

d) The companies who generously contributed towards the success of our program.

e) Mr. Thor Hansen of the British American Oil Co. Ltd. for his stimulating after-dinner address: "Culture by the Bushel".

f) Dr. D. L. Bailey and the members of the Panel.

2. Be it resolved that the society extend its best wishes to those members who have retired since our meeting in 1958: W. F. Hanna, G. H. Berkely, D. J. MacLeod, and B. Peterson.

3. Be it resolved that the society pay tribute to former members who have died since our meeting in 1958: K. W. Neatby, A. R. Walker, J. L. Howatt, Omer Caron and J. Keith Richardson.

Since our meeting at Wolfville in 1958, we have lost a member who merits special recognition. K. W. Neatby, a geneticist and plant breeder, worked closely with plant pathologists and studied the genetics of resistance to cereal diseases in his personal research. To the end of his life he maintained a deep interest in the field of plant pathology, and a high regard for the achievements of its practitioners. The plant pathologists in the Canada Department of Agriculture shared with other research workers in the tremendous improvements Dr. Neatby helped effect in our facilities, equipment, and encouragement to do good scientific work. As plant pathologists, we may have even more reason than most to lament his untimely death. I ask you to rise and observe a minute of silence in this belated tribute to an outstanding scientist, an outstanding and courageous research administrator and our very good friend.

Resolutions 1 - 3 were passed unanimously.

4. The affiliation of the Canadian Phytopathological Society with the Agricultural Institute of Canada has been valuable in making arrangements for annual meetings and similar administrative matters. The A.I.C. does not, however, take the place of an association of biological societies, and its interests and the scientific interests of the C.P.S. coincide at relatively few points.

There would be real benefit to the C.P.S. and to other botanical and biological societies if they could hold joint scientific meetings, attended only by people interested in their scientific content.

Such joint meetings could provide the close personal contact and opportunity for discussion with workers in other but related disciplines now largely unavailable at the A.I.C. conventions. As they would presumably not be family holiday conventions, such meetings would involve fewer people than A.I.C. conventions, and accommodations would be easier to arrange. Some of the groups with scientific interests close to those of the C.P.S. are the Societies of Plant Physiologists, of Microbiologists, and of Geneticists.

Because of the continuing interest in the possibility of affiliation with other biological societies, discussed previously at our 1958 meeting, be it resolved that the implications of such a change in affiliations of the C.P.S. be investigated thoroughly, and that a half-day be devoted to discussing it at the next annual

meeting, with representatives of other interested societies and the A.I.C. invited to participate.

Resolution moved by W. E. Sackston and seconded by F. R. Forsyth. After discussion R. A. Ludwig moved and W. C. Broadfoot seconded the following amendment:

Be it resolved that the desirability of meeting with societies other than the A.I.C. without changing the affiliation of the C.P.S. be investigated by the incoming executive and reported at the next annual meeting. Resolution as amended, carried.

5. Canadian plant pathologists currently publish in various botanical and agricultural journals produced in Canada, the United States, and elsewhere. The facilities for publication have usually been good, but the lack of a Canadian journal devoted to plant pathology has lessened appreciation of the true scope and extent of phytopathological research in Canada.

   As the number and quality of the papers currently being published by Canadian plant pathologists, and the prospects for continued support in the future are sufficient to warrant the establishment of a separate journal, be it resolved that the Canadian Phytopathological Society meeting at Guelph in June 1960, appoint a committee to compile supporting data, and to meet with the President of the National Research Council, and the Deputy Minister of the Canada Department of Agriculture, to point out the need and to press for the establishment of a Canadian Journal of Phytopathology.

   Resolution moved by W. E. Sackston and seconded by S. G. Fushtey. After discussion R. A. Ludwig moved and W. C. Broadfoot seconded the following amendment: Be it resolved that the incoming executive consider the need of a Canadian Journal of Phytopathology and report at the next annual meeting. Resolution as amended, carried.

6. Whereas plant disease surveys are a prerequisite to intelligent planning of plant disease research, to the estimation of plant disease losses, to the interpretation of plant disease phenomena, to better teaching and extension work, and are important in many other ways

   Whereas more comprehensive plant disease surveys are needed in Canada

   Whereas present workers, through pressure of their primary responsibilities, can give little time and attention to such survey work

   and whereas insufficient recognition and financial reward is at present given for such survey work

   therefore be it resolved that additional personnel be provided for plant disease survey work in Canada and that more recognition and financial support be given those persons engaged in this important phase of plant pathology.

   Resolution moved by W. E. Sackston and seconded by D. W. Creelman.

   Resolution was carried after it was amended to read — "that the Canadian Phytopathological Society recommend to appropriate authorities —".

7. The reorganization of the research activities in the Canada Department of Agriculture has eliminated the former Divisions. As Divisional meetings can no longer be held, and similar opportunities for most plant pathologists in the Research Branch to meet at one time may be few, the C.P.S. will provide the only common bond holding together the fragmented groups of plant pathologists in the public service.

   Such a bond of professional interest for the devotees of a scientific discipline is as important to good morale and good research as their pride in the institution where they work.

   Attendance at C.P.S. meetings can strengthen professional ties, and by providing opportunities for discussion of scientific work of mutual interest can indicate new approaches to difficult problems and can result in better research efforts.

The recent Treasury Board rulings that only one representative of a Research Station may attend a convention such as the A.I.C. meetings, have been interpreted at some stations in such a way that a member of only one of the societies affiliated with A.I.C. has been permitted to attend the various scientific meetings being held in conjunction with the A.I.C.

Because the existence of such rulings, and this kind of interpretation of them can cripple the scientific societies currently affiliated with the A.I.C.

Be it resolved that every effort be made to have the ruling changed or to broaden its interpretation, so that each Station or other establishment in the Research Branch be permitted to send members of the various scientific societies to the meetings of their respective societies, whether held separately or in conjunction with other groups.

A. J. Skolko moved and R. A. Ludwig seconded a motion that this resolution be referred to the incoming executive. Carried.

ABSTRACTS OF PAPERS PRESENTED AT THE TWENTY-SIXTH MEETING OF THE CANADIAN PHYTOPATHOLOGICAL SOCIETY

VERTICILLIUM DISEASE OF STRAWBERRIES

P. K. Basu, Botany Department, University of Toronto, Toronto, Ont.

An intensive study was made of the morphology, cultural characters and infection capabilities of 18 isolates of *Verticillium*. These were in part isolated from different *Verticillium* hosts occurring in the Niagara Peninsula and the balance were obtained as named stock cultures from different herbaria. In terms of their pathogenicity to strawberries, resistant and susceptible tomatoes and eggplants the isolates comprised a number of races whose virulence ranged from lethal to very mildly pathogenic. Under the experimental conditions, current year runner plants of strawberries proved to be virtually immune from infection in contrast to normal over-wintered plants. The symptoms on the strawberry are variable and diagnosis should be confirmed by isolation for which a technique was evolved. Wound infection courts significantly increased the disease incidence. Morphologically the isolates varied considerably and in cutural characters where the colour ranged from white through gradually deepening gray to black. At the extremes the differences were conspicuous but were so intergrading in the group as a whole that they are regarded as belonging to one variable species which, because of priority must be called *Verticillium albo-atrum* R. & B.

GROWTH OF SOIL FUNGI ON SOIL EXTRACT MEDIA

W. G. Benedict, Department of Biology, Essex College, Assumption University of Windsor, Windsor, Ontario.

When 20 different soil fungi isolated by the dilution plate method were grown on extract media of 10 different types of soil, significant differences in the growth of some fungi occurred. *Torula convoluta* showed the most varied growth response in different soil type extract media. In general, extracts from clay soils stimulated and extracts from loam soils retarded fungus growth. Sand and muck soils were intermediate and bottom land soil extract consistently retarded fungus growth wherever differences were evident.

THE EFFECT OF *ERWINIA CAROTOVORA* ON ROOT GROWTH OF BARLEY

W. G. Benedict, Department of Biology, Essex College, Assumption University of Windsor, Windsor, Ontario.

A cell-free filtrate of cultures of *E. carotovora* suppressed growth in barley roots by enzymic activity without maceration of primary tissues. The effects were

incited by the extra-cellular metabolities of a large population of the bacterium, following growth on a favourable medium, on barley roots immune from infection by *E. carotovora*. Only the zone of cell division in the late meristematic stage of growth was affected by the filtrates of the bacterium. The result was a significantly less than maximum mitotic activity in this region of the root compared with growth in water.

THE SAPROPHYTIC POTENTIAL OF *COLLETOTRICHUM ATRAMENTARIUM*

J. A. Clark, Department of Botany, Ontario Agricultural College, Guelph, Ontario.

Colletotrichum atramentarium grew more actively in autoclaved than in non-autoclaved soil and apparently was not well adapted to invade organic residues when forced to compete with other microorganisms. However, in the presence of a living host or viable fragments of host tissue, the ability of *C. atramentarium* to be parasitic appeared to offer some competitive advantages. The failure to demonstrate growth of *C. atramentarium* through soil from colonized tissue (food base) suggested that the fungus remained dormant in its non parasitic phase. It is considered, then, that *C. atramentarium* according to the terminology of Garret, could best be described as a root-inhabiting fungus, rather than as a soil-inhabiting fungus.

A STILBOID FUNGUS FROM THE RHIZOSPHERE OF RED CLOVER

R. H. Estey, Macdonald College, Quebec.

An undescribed stilboid fungus has been repeatedly isolated from washed, whole roots of red clover when they were floated on, or partially submerged in tap water containing streptomycin sulfate in sufficient concentration to inhibit the multiplication of bacteria. Although this fungus is suspected of being mycorrhizal, its relationship to the clover roots has not been definitely determined. When isolated from the clover roots, this fungus may be cultured on a variety of media in a wide range of environmental conditions. Its stilbiform fruiting structures, which are positively phototrophic, are produced in concentric zones in response to alternating periods of light and darkness.

FIELD RESISTANCE TO POTATO LATE BLIGHT

W. A. Hodgson, Research Station, Canada Department of Agriculture, Fredericton, N.B.

Studies on the field or minor gene resistance of the potato to late blight have shown that the resistance of leaves varies with age. The lower leaves from vigorously growing plants were found to be more susceptible to disease than were leaves from the middle or top parts. Similarly, leaves from the middle of the plant were more susceptible than leaves from the top. Resistance was also found to be dependent upon the concentration of inoculum used. A more concentrated inoculum was required to cause disease in highly resistant varieties than in varieties known to be only moderately resistant under field conditions.

TRANSMISSION OF POTATO LEAF-ROLL AND TURNIP-LATENT VIRUSES BY SINGLE APHIDS

J. P. MacKinnon, Research Station, Canada Department of Agriculture, Fredericton, N.B.

Aphids *(Myzus persicae* (Sulz.)), infective with potato leaf-roll virus (LRV), were placed for two days on plants infected with the unrelated turnip-latent virus (TLV). Each aphid was then moved daily, as long as it lived, to different *Physalis floridana* Rydb. test seedlings on which infections of either or both viruses could be distinguished. Aphids that first acquired LRV later acquired and transmitted TLV as did other aphids that were infective with TLV only. In similar tests, aphids that first acquired TLV later acquired and transmitted LRV as readily as aphids carrying only LRV. When virus-free aphids were allowed to feed for two days on doubly-infected plants and then moved daily to new test plants, each aphid apparently acquired and transmitted either virus independently of the other.

SOME EVIDENCE OF ANTAGONISM BETWEEN UNRELATED VIRUSES IN THE TOMATO-STREAK COMPLEX

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Simultaneous infection of the tomato by the tobacco mosaic virus and potato virus X produced a severe terminal necrosis at 72°F., the disease being recognized as streak. Prior infection of the tomato host by PLV (a strain of TMV) reduced the severity of the disease following infection by the X component of the streak complex. No such evidence of antagonism was noted when infection by X preceeded PLV.

FACTORS AFFECTING THE GROWTH OF THE FILAMENTOUS FUNGUS, *HIRSUTELLA GIGANTEA* PETCH

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The fungus genus *Hirsutella* comprises 33 named species that have been reported from a wide range of naturally infected insect species, as well as from members of the class Arachnida. Nutritional studies on one of the species, *Hirsutella gigantea* Petch, isolated from spruce budworm larvae, *Choristoneura fumiferana* (Clem.) have been under investigation for the past several years.

It was shown that the fungus does not grow in a basal dextrose-salts medium with potassium nitrate or ammonium nitrate as the nitrogen source. There is a substantial increase in growth when yeast extract, tryptone, or liver fraction "L" is added to the basal medium. The beneficial effect is distinctly marked when yeast extract and glucose are both added to the medium in concentrations of 1.5 and 2 per cent respectively.

In an attempt to explain the stimulatory effect of yeast extract, the utilization by the organism of nitrogen from 39 specific sources were tested. It was found that while amino acids singly and in combination may produce varying amounts of growth with *H. gigantea,* no combination tested to date equalled acid-hydrolysed casein as a nitrogen source in a simple dextrose-salts medium sown with 0.1 mg of inoculum. It was concluded that the significant difference in growth of the fungus on the amino acids on the one hand and natural casein hydrolysate on the other, is due to unidentified growth factor(s), possibly peptides, present in casein hydrolysate.

A number of possible growth factors were tested in a basal-dextrose — (L-glutamic acid) — salts medium to determine whether they duplicated the growth-promoting activity of the natural products. Ten of the B complex vitamins were checked individually and in mixtures. The results indicated that separately the vitamins had no effect, although the whole vitamin complex did stimulate growth slightly. The addition, however, of a yeast nucleic acid preparation produced a much superior yield, and a synergistic effect was noted when this substance was introduced in combination with the B complex.

The yields obtained with the vitamin-nucleic acid preparation varied somewhat when three other nitrogen sources were substituted for L-glutamic acid in the basal medium. This would seem to indicate some interdependence between the source of nitrogen and the growth supplements.

AN OCCURRENCE OF TOMATO RINGSPOT VIRUS ON GREENHOUSE CUCUMBER IN ONTARIO

C. D. McKeen, Research Station, Canada Department of Agriculture, Harrow, Ontario.

In April 1957, the writer was summoned to a range of greenhouses near Kingsville, Ontario, to investigate a serious virus infection of Burpee hybrid cucumbers. Symptoms of systemic infection consisted of yellow to tan-colored spotting of leaf laminae followed later by tan-colored necrotic areas that spread slowly along the

veins ultimately killing the leaves. Oily-appearing, brownish areas that developed along the stems were particularly conspicuous at the nodes. Many infected plants wilted and died. Studies with isolates from infected plants showed that two distinct strains of tomato ringspot virus were involved. Invariably the virulent strain proved lethal to Burpee hydrid cucumber regardless of plant age at time of inoculation. Death of infected mature cucumber plants resulted from foot rot incited by *Fusarium* sp. and *Pythium* sp. that invaded stems at or below soil level. Handling of plants proved to be the chief means of transmission of the viruses in the greenhouse.

AN OVERWINTERING HOST FOR TOBACCO ETCH VIRUS IN SOUTHWESTERN ONTARIO

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During the last decade tobacco etch virus (TEV) has caused serious losses in burley tobacco and in sweet pepper crops in the Harrow area of southwesthern Ontario. From a search to establish a perennial weed that might function as an overwintering host for TEV, to date only ground cherry *(Physalis)* has been found to act in this capacity. A consistent association has been established between the occurrence of etch in *Physalis heterophylla* growing along fence rows and in waste areas and the occurrence of etch in tobacco and pepper crops growing in nearby fields. In high incident etch areas 25% of *P. heterophylla* plants were found to harbour etch. *P. subglabrata,* a less prevalent species, has been demonstrated to carry etch. The means by which TEV may be transmitted from overwintering resevoirs to commercial crops is being investigated.

THE RELATION BETWEEN AGE OF SEED AND THE DEVELOPMENT OF LOOSE SMUT IN BARLEY

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In 1954 the author reported the results of his investigations on the influence of loose smut on seedling vigour in barley. He found that embryos and seedlings infected with *Ustilago nuda* (Jens.) Rostr. were somewhat weaker than healthy ones. However, the difference in vigour was not great and a close correlation existed between the percentage of seeds infected and the percentage of smutted plants that developed when the seed was sown in the field.

Further studies have been conducted over a period of ten years with fifteen samples of infected seed barley. Portions of each seed-lot were sown annually in the field. For about five years there was no marked reduction in the percentage of plants infected. During the last five years, however, the percentage of smut has been falling steadily. Recent experiments have shown that the main reason for this decline in percentage infection is the fact that infected seeds are losing their viability faster than the smut-free seeds.

COMPARATIVE STUDY OF THE MICROBIAL DEGRADATION OF THE SCLEROTIA OF *CLAVICEPS PURPUREA* (FR.) TUL. AND *SCLEROTINIA SCEROTIORUM* (LIB.) DEBARY IN NATURAL SOIL

N. Sharan and A. W. Henry, University of Alberta, Edmonton, Alta.

A comparative study was made of the microbial degradation of treated and untreated sclerotia of *Claviceps purpurea* (Fr.) Tul. and *Sclerotinia sclerotiorum* (Lib.) DeBary in natural black soil of the Edmonton (Alta.) district, moistened and incubated in Petri dishes at 15°C. Treatment consisted in immersion of the sclerotia in a 1:1000 solution of mercuric chloride for 1 minute.

It was found that the percentage of sclerotia attacked by micro-organisms following treatment was far greater for *C. purpurea* than for *S. sclerotiorum.* As a conse-

quence treated sclerotia of *C. purpurea* sown in natural soil germinated poorly or not at all, whereas those of *S. sclerotiorum* germinated well.

AGROPYRON MOSAIC AS A DISEASE OF WHEAT IN ONTARIO.

John T. Slykhuis, Plant Research Institute, Canada Department of Agriculture Ottawa, Ontario.

Agropyron mosaic virus (AMV) is common on *Agropyron repens* and can be found occasionally on wheat in southern Ontario. Although normally mild on wheat, it resembles wheat streak mosaic virus (WSMV) in many respects, and strains of AMV have been selected that cause more severe chlorosis than WSMV, and significant but less severe stunting and yield reductions than the latter. Differential hosts include *A. repens* which is susceptible to AMV but not to WSMV, and oats which is susceptible to WSMV but not AMV. The incubation periods of the two viruses on wheat were equal at 20° to 25°C, but AMV developed more rapidly than WSMV at 10° and 15°C, and more slowly at 30°C. In sap of infected wheat grown at 20°C, AMV was ¼ as infective as WSMV. AMV was slightly less stable than WSMV in crude sap stored at 20°C. Infectivity was destroyed by heating for 10 minutes at 50°C for AMV and 60°C for WSMV. Particles of AMV are similar in shape but thicker and longer than WSMV particles. Eriophyid mites appear to be associated with the natural transmission of AMV, but *Aceria tulipae*, vector of WSMV, did not transmit AMV. Strains of AMV were snyergistic in combination with all but one strain of WSMV when tested on wheat.

FURTHER STUDIES ON THE INFECTION OF WHEAT BY HELMINTHOSPORIUM SATIVUM

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In earlier work the detached leaf method was used to study infection reactions with *H. sativum*. The present report deals with infection tests of seedlings and adult plants. Seedlings grown in culture tubes were inoculated at the coleoptile area. Good lesions developed and soon the first leaf became chlorotic and died when the seedlings were supported only by water. Such injury was prevented by using a weak potassium nitrate solution in place of water. Adult plants were inoculated either at the crown or in the peduncle zone with positive results in most cases. The grain from these plants was lower in nitrogen (and protein) than grain from comparable healthy plants. An examination of grain from field collections indicated a trend for more piebaldness, a sign of nitrogen deficiency, in kernels from severely diseased plants. It is concluded that the colonization of *H. sativum* in wheat plant tissues (lesions) drains varying amounts of nitrogen from the host.

INFECTIVITY STUDIES ON POTATO VIRUS X AND ITS VIRUS NUCLEIC ACID

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Infectious ribonucleic acid (RNA) was obtained from potato virus X (PVX) by means of the guanidine hydrochloride denaturaton. The infectivity of the whole virus and the RNA was compared on two different test plants, *Chenopodium amaranticolor* Coste. & Reyn. and *Gomphrena globosa* L., both of which develop local lesions when inoculated with PVX or infectious RNA. Stock solutions producing approximately 50 local lesions per half leaf on *G. globosa* were diluted 2, 4, 8, 16, and 32 times for infectivity comparisons on the two hosts. The two hosts differed markedly in their response. For example, 40 local lesions were obtained on *G. globosa* with a RNA and PVX preparation whereas on *C. amaranticolor* the same preparations produced 65 and 11 local lesions respectively. Thus when the relative infectivity of the RNA preparation was determined on *C. amaranticolor* and *G. globosa* the results obtained on the former host were approximately 5·7 times as high as on the latter host.

SEROLOGICAL STUDIES OF STONE FRUIT VIRUSES

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Preparations of isolates of cherry yellows, necrotic ring spot, green ring mottle, prune dwarf, tatter leaf and peach necrotic spot viruses have been employed in antisera production and subsequently as antigens in gel diffusion precipitin tests. Some viruses were found to fragment into subunits upon purification by differential centrigufation (following clarification of infected cucumber sap by dialysis).

Cherry yellows virus was most stable and no evidence of its fragmentation was observed in purification. Necrotic ring spot, prune dwarf and green ring mottle viruses were less stable and a single breakdown product has been observed in addition to virus in preparations immediately after purification. Similar preparations of tatter leaf virus contained at least 3 components of viral origin.

A different breakdown product, detected in preparations of most of these viruses after a few weeks in cold storage, appeared to be identical with an antigen present in the sap of infected cucumbers.

These results substantiated observations made by electron microscopy, analytical ultracentrifugation and ultraviolet spectrometry.

PLANT PATHOLOGY IN CANADA — TODAY

Summarized by D. L. Bailey

Because Canada was host to the IXth International Botanical Congress, no meeting of the Canadian Phytopathological Society was held in 1959. However, Canadian pathologists attending the Congress took part in several informal discussions and showed a general concern with the present and immediate future of plant pathology in Canada. The problems that worried them were the shortage of Canadian students entering the field of plant pathology; the number that we were losing to the United States; and in losing the Division of Botany, plant pathology had lost or would lose its status and identity in Canada. Therefore, the executive of the society decided it might be helpful to review the problems presently facing plant pathology at this year's annual meeting and accordingly Prof. D. L. Bailey of the University of Toronto was asked to organize and chair a panel discussion on this subject. He chose the following panel members: Professors B. H. MacNeill, C. B. Kelly, Ont. Agric. College; Dr. L. W. Koch, Director, Harrow Research Station; Dr. R. A. Ludwig, Director, Kentville Research Station; Dr. W. E. Sackston, Head, Plant Pathology Laboratory, Winnipeg; and Dr. R. Stace-Smith of the Virus Research Laboratory, Vancouver.

Since the terms of reference suggested the desirability of a wide ranging discussion, four major fields were considered, as indicated in the following agenda, mimeographed copies of which were distributed at the meeting. Participation from the floor was invited and as the discussion developed the chairman directed questions indiscriminately among the large and representative audience. Time did not permit an exhaustive treatment of any of these fields and, in the interest of a spontaneous uninhibited discussion, the programme was not taped nor were verbatim records attempted. It is possible therefore to report only in very general terms what did take place.

Agenda for Panel discussion "Plant Pathology in Canada — Today"

Fields of Discussion: Problems associated with

I The Recruitment of New Personnel

II The Training of New Recruits

III Organization of Phytopathological Research

IV Research Fields and Emphasis. Are we blazing the right trails ? With the best shading of emphasis ?

I Recruitment of New Personnel

(a) Attracting students at the school and college levels.

(b) Support for undergraduate students through summer appointments.

(c) Professional opportunities in relation to recruitment;

Availability of positions; Salary scales; Advancement opportunities; Research opportunities.

(d) How many recruits are required ?

II The Training of New Recruits

(a) Foundation: Does the basic undergraduate course matter provided it lays a satisfactory foundation in biology?

(b) Specialization: When should this begin? What degree is desirable for the Ph.D. student ? Should specialization rest primarily on a crop basis ?

(c) Centres of Training: Should we have more or fewer centres of graduate training ? Among these centres should there be some planned apportioning of special fields ? What is the responsibility of the Government Research Stations in supporting graduate training ?

III Organization of Research

(a) How desirable and how feasible at the present time is the separation of research and extension phases of pathology ?

(b) If the essential raison d'être of the present scheme of organization of research in the Dominion Service is to enhance the integrity of its various research centres and challenge each of them with the responsibility of maintaining a dynamic research effort;

(i) How effectively is this scheme working out ?

(ii) Is it consistent with a separate centralized programme directorate?

(iii) Should inter-laboratory conferences of the order of the old Divisional Conferences be retained ?

(iv) How otherwise can we, as pathologists, maintain the unity and solidarity we lost with the dissolution of the Division of Botany?

IV Research Fields and Emphasis. Are we blazing the right trails ?

With the best shading of emphasis ?

(a) What phases are conspicuously neglected ?

(b) Are any phases threatening to get out of hand ?

1. The Recruitment of New Personnel.

Interest in this phase was general and the discussion was active. It was conceded that over the past decade there had been a steady decline in the number of Canadian students completing Ph.D. training in Pathology until now in certain years no such graduates were available. In contrast with this, Dr. Skolko reported that merely to maintain the pathology staff of the Can. Dept. of Agric. was likely to require some 3 or 4 new appointments per year for many years.

When the background of this emergency was explored, it became apparent that, in the history of the development of plant pathology in Canada, there had been two conspicuous peaks of expansion, the first of which had been shortly after the first great war. A large group of substantially the same age recruited at that time were now reaching the point of retirement within such a short period that replacing them created a unique and difficult situation. Since, even though they were available, recruits could not be trained in time to fill these vacancies, this obviously is a problem

in itself. It was felt that the Department might well utilize the services of pathologists beyond the present age limit more generally than is presently being done. Pathologists will have to be sought from other countries, but here, since other countries are facing the same shortage, increasing difficulty will be encountered in moving the really competent individual, which is the only type we can afford to import. The exigencies of the situation may well force a return to a previously utilized device of filling many of these positions with promising recruits who have minimum qualifications. Educational leave should later be extended to these individuals to improve their training. While it was conceded that many presently employed in the Department had followed this procedure, it was the unanimous opinion of those directing research that the scheme was demoralizing to the research program and that expediency was its sole justification.

An attempt was made to define what might be considered a reasonable replacement rate in the federal pathological services. Dr. Skolko said a recent survey revealed the following information concerning plant pathologists in Canada.

Number of Plant Pathologists

Can. Dept. Agric., Plant Pathology & Mycology	132	.....	(58%)
Forest Pathology	40	.....	(18%)
Can. Dept. Non-Agric. — Forest Service	3	.....	(1%)
National Research Council	5	.....	(2%)
			79%
Others:			
Provincial	13	.....	(6%)
Universities	33	.....	(15%)
			21%

While the objective may not be easily attained, the desirability of avoiding such recurring peaks of replacement, separated by times of acute shortages in available positions, is apparent. It was pointed out that a second peak of replacement is virtually inevitable several years hence. If the demand could be evenly spread, the problem of available personnel should not be acute.

The discussion returned to the problem of recruiting new personnel. It was agreed that we are perennially in a difficult position through being overshadowed by the widely recognized professions like engineering, medicine, dentistry, law, etc. Not only are they better known, but also they have relatively enormous absorptive capacities, higher average monetary returns without longer periods of training and, in most cases, opportunities for research careers. This highlighted the necessity of a great deal more positive action in making the whole field of biology better known to the public and the opportunities for the diversified careers it offers better known to students. The possibility of placing a brochure on plant pathology in the hands of Guidance teachers seemed worth exploring and it was agreed that no biologist should remain complacent with respect to most of the present high school curricula in biology or to the constanly decreasing number of schools where only an inadequate introductory course is available. Since educational matters are in provincial hands, this subject appeared to be one which regional groups could consider to advantage and implement such action as seemed advisable.

Of the biological courses, botany presently appears to be coming out second-best. Even within the field of botany, pathology no longer holds the preferred position it once had. The discussion indicated, however, that this whole situation was much involved and varied from place to place. The large number of able students which the late Prof. W. T. MacClement of Queen's University steered into pathology and mycology is an impressive demonstration of the effectiveness of dynamic undergraduate teaching and the importance of introducing students to pathology at that level. Some felt we were still somewhat under the shadow of the job scarcity of the depression years and those that followed, and of the ceiling on new positions which for years was the affirmed policy of Science Service. University members all agreed that nothing would help more in attracting college students to plant pathology than early negotiated summer appointments. From the spirited discussion

that centred around such appointments, it seemed that perhaps universities had been too complacent with respect to them and should accept more responsibility in contacting their nearest Federal Research Station with respect to financing promising students during the summer months. The attitude toward such appointments varied greatly among the Directors of these Research Stations. While all of them agreed that summer appointments were effective and legitimate in attracting good students into pathology, a few felt they were otherwise useless to the laboratory concerned and likely to reduce their budget for trained technical assistance; while others found them useful and even the source of their best temporary help. Some had found that such appointments could be greatly expedited by personal contacts with the Officer-in-Charge of their Regional Civil Service Office.

It was generally felt that, with respect to the recruitment of new personnel, Research Laboratories of the Can. Dept. of Agric. are in a strong position so far as research opportunities were concerned. The widest possible latitude is offered in the selection of a field of research and, regardless of the choice, well equipped labs are available for carrying out the research. While excellent in itself, this wide ranging inclusive Federal activity has virtually precluded any comparable development at the Provincial level and thus has eliminated the competition for personnel.

The situation with respect to salary range and prospect of advancement was likewise significantly improved by the recently announced increase to Canada Dept. of Agric. research personnel. It is probable that next year recruitment at the Ph.D. level will be at a salary of $6,540, i.e., at the middle of the new R.O. (A)2 classification. However, the level in the Grade 2 range at which the appointment is made depends to some extent upon the experience and research productivity of the applicant. From this salary level research officers in the Can. Dept. of Agric. may proceed upward to the R.O. (A)5 level, the maximum salary of which is $11,200 at present.

II The Training of New Recruits

(a) Foundation: It was considered that Plant Pathology might be elected by a student engaged in an Agricultural Course, Forestry Course or the biology option of an Arts Course and that his background would likely influence his approach to the subject. The background was felt to be adequate, however, if it did not limit the subsequent activity and development of the individual. To avoid this, it should rest on the broadest biological foundation as possible. Such a foundation was not readily delineated but, ideally at least, within the sciences it should comprise, in addition to botany and zoology, physics, chemistry — inorganic, organic and preferably some biochemistry, and mathematics, including basic calculus. Actually however, it should be feasible for most students to cope with specific subject-matter deficiencies as a part of their graduate studies. It appeared therefore that the basic background training is not as pressing an issue as it used to be.

(b) Specialization: The discussion indicated the dangers of generalizing with respect to specialization in student training. There seemed general agreement that mere concentraton on diseases on a crop basis was an unsatisfactory basis for student training, however desirable it might be that students spend enough time in the field to become familiar with some diseases there and attempt if possible to resolve some problem of epidemiology.

If pathology is going to compete with other botanical specialties for the best students, they should have some contact with pathology at the undergraduate level. When formal courses in pathology can not be arranged, discrete sections of existing courses dealing with plant diseases and their control should be set up. Summer laboratory experience should also be arranged for a few of the best first year students in the hope that they will become interested in pathology.

With respect to the degree of specialization most appropriate to graduate training, the chairman ventured the opinion that the inherent danger here was not so much excessive specialization as it was professionalism, which he regarded as a serious and ever-present threat to Ph.D. standards and adequate student training. Except in those cases where a student is prepared and suited to undertake an intensive attack on a specifically delineated problem, thesis problems should be chosen whose initial explor-

ation for promising workable leads will initiate the student into the realm of plant pathological research. Later his prosecution of such leads can be as specialized and refined as he is able to make it, without danger of narrowing his horizon or warping his perspective.

(c) Centres of Training. It was pointed out that Ph.D. degrees in one or more phases of plant pathology could presently be obtained in many Canadian universities. These include Macdonald College of McGill University, the Ontario universties of Queens, Toronto, McMaster, and Western, the prairie universities of Manitoba, Saskatchewan and Alberta and the Univ. of British Columbia. The opinion was expressed that a student usually chose to work with a certain man rather than at a particular university and that this was essentially as it should be. However, the first line training centres in plant pathology in the United States are able to offer sessional or yearly appointments to Canadian graduate students vastly more attractive remuneratively than comparable appointments or scholarships in Canadian universities. This would be much less disturbing if students so trained returned to Canada in larger numbers than has heretofore been the case.

There was considerable discussion and some differences in opinion as to whether or not and to what extent the well equipped government laboratories located on university campuses and their outstanding staffs could and should be used in connection with the research training of graduate students. Members of such laboratories who were present felt that the universities concerned were primarily responsible for their staff and equipment not having been used more generally and that such co-operation was feasible with respect to equipment alone or, in addition, joint supervision of student researches. It was pointed out that in such co-operative efforts, the ultimate responsibility rested with the universities and that this could never be abrogated. However, one person expressed some doubt as to whether joint supervision of student researches was really feasible in actual practice and whether the co-operative use of Government laboratory equipment would not make it still more difficult for university departments to build up their own essential equipment.

The scheme of educational leaves presently operating within the Dept. of Agric. was commended as being both generous and farsighted. The universities appear to have encountered no great difficulty in the way it operates, although the laboratories from which such students come tend to find such leaves disruptive to their research programme.

III Organization of Research

(a) It appeared to be fairly generally agreed that the separation of the research and extension phases of pathology was not desirable. If they were divorced, Horsfall's predication would probably be realized that extension would run out of ideas and research would starve. It was stressed that competent research workers are sometimes congenitally incapable of doing good extension work and should not be expected to do so. Nevertheless, it seems desirable that all research workers should have a field acquaintance with the problem with which they are concerned.

The ultimate objective of the Canada Department of Agriculture's plant pathological researches is the control of plant diseases and hence its research programme must be conceived and directed in terms of acute economic pressures. This implies a broadly based and highly integrated approach that avoids unprofitable imbalances. For example, the elucidation of mechanisms of pathogenesis can not be counted on to point the way to a control or assist in furthering it in those cases, like the viruses, where it is most difficult. Logically projected this suggests that the direction of research should be in the hands of persons who know the epidemiology of their problems.

(b) — (i) Tribute was paid to the late Dr. K. W. Neatby for his vision and regret expressed that he had not lived to see his re-organization in operation and guide its development.

It was agreed that the existing scheme had been in operation for too short a period to assess how effectively it is working. The principle of the re-organization seemed sound and hence there should be no insuperable difficulties in making it

work. Indeed, this should be relatively simple in pathology where the re-organization had occasioned much less change than in most other disciplines.

(b) — (ii) The function and operation of the Programme Directorate was freely discussed. It was stressed by members of the Programme Directorate, but not unanimously accepted by other echelons, that this was in no sense a burdensome administrative hierarchy, but in reality a simplification of the Science Service Administration. Thus the work of 12 Division Chiefs is now being carried by 4 Program Directors and a 22 man Board of Directors now administers a Research Branch with a personnel of some 4600 and 60 research units. Substantial administrative responsibilities, however, are now inherent in the regional units. The primary function of this Board is the National co-ordination of the research programme. The chief advantage of the present system is felt to be a closer integration of the research workers in the various disciplines which results from the elimination of the old divisional lines and a greater fluidity of staff, since positions can now be changed readily from one laboratory to another.

(b) — (iii) and (iv) The question was raised whether from a professional standpoint we had not lost something in unity and solidarity as pathologists with the dissolution of the Division of Botany and Plant Pathology. Many felt we had suffered important but intangible losses in esprit de corps and that recruitment would be more difficult. To counter this it was suggested that meetings akin to the old Division meetings should be continued, and that the C.P.S. should strive to provide unity among Canadian pathologists, perhaps initially by a monthly newsletter, and by further strengthening of the Regional Groups. This problem might well be referred to these Groups for consideration and recommendation next year.

IV Research Fields and Emphasis

During the past two years we have had, in the American Phytopathological Society's Jubilee programme and that of the IX International Botanical Congress, opportunities to compare the status of Canadian pathology with that in the rest of the world. It was felt that a discussion of this phase would prove interesting and, in addition to an assessment of the adequacy of our efforts, bring to light what fields were being neglected and which, if any, were perhaps receiving proportionately too much attention. Unfortunately, however, the session had already lasted for 3 hours and the hour was late, so the Chairman terminated the discussion at this point. He turned the meeting over to Dr. Cormack who thanked the panel and all the others who had participated in the discussion.

THE ORGANIZATION AND DEVELOPMENT OF PLANT PATHOLOGY IN CANADA*

D. L. Bailey

In 1909 a separate Division of Botany was created within the Dominion Experimental Farms System, which had been organized in 1896. Its director was Dr. H. T. Güssow who held the position of Dominion Botanist until his retirement in 1944, at which time his Division comprised some 15 regional laboratories scattered from coast to coast. Their distribution paralleled that of the Branch Experimental Farms and initially they were under strong economic pressure to survey and assess local plant disease situations; to determine the relative susceptibility of available varieties to locally threatening pathogens; to recommend the best seed treatments, especially with respect to cereal smuts: to evolve suitable fungicidal spray and dust treatment for orchard diseases, especially apple scab and to carry on local extension work. These laboratories gradually developed and expanded a research effort directed at unsolved problems and a better understanding of the epidemiology of many, about which already much was known. This regionalization tended to limit the number of laboratories, to avoid unnecessary duplication of plant and expensive equipment, and encouraged the development of specialized laboratories dealing with certain phases of the research effort such as Cereal Root Rots, Cereal Rusts, Stone Fruit Viruses, Seedborne diseases, Potato Viruses etc. University campuses, because of their library and other facilities became the preferred locus of these regional research laboratories, which come to be located at the provincial universities in the four western provinces of Manitoba, Saskatchewan, Alberta and British Columbia, as well as at the University of Western Ontario, at Laval University in Quebec and at the University of New Brunswick in Fredericton. In addition to these, there were off-campus pathology laboratories at Saanichton on Vancouver Island; Lethbridge, Alberta; St. Catharines, Harrow and Ottawa in Ontario; Ste Anne de la Pocatiere, Quebec; Kentville, Nova Scotia and Charlottetown, P.E.I. and Forest Pathology laboratories in Victoria, B.C., and Calgary, Alberta. Until very recently these laboratories have continued to be administered by the Dominion Botanist as Head of the Division of Botany. Dr. Güssow retired in 1944 and succeeding him were Dr. J. H. Craigie (1945-1952) and Dr. W. F. Hanna (1952-1958).

In 1937 the Experimental Farms Divisions concerned with botany, entomology, chemistry and bacteriology were segregated into a newly created Science Service Branch. Its first Director, Dr. J. M. Swaine, served from 1937-1945 to be followed by Dr. K. W. Neatby who held the position until his untimely death in 1958. Under his energetic and imaginative direction Science Service became a well coordinated organization with first class facilities for research, housed in a chain of large, well equipped laboratories which are a memorial to his wisdom and vision. By housing in a single laboratory, scientists of different specialties and interests, it was hoped that coordinated team approaches to the investigation of all problems would be encouraged. Since the Dominion Botanist was also an Associate Director of Science Service, the organization of the plant pathological units was little changed.

During the last years of his life, Dr. Neatby gave much time to evolving a scheme the objective of which was the unification of research in the whole Department of Agriculure within a single Research Branch. Unfortunately his untimely death in 1958 deprived us of his much-needed leadership in implementing this scheme. This is not the place to consider its details. The Division of Botany along with the others, disappeared as an administrative unit. A Program Directorate is charged with the planning and integration of the research programme and the five Directors will have responsibility for the work in the respective fields of Animals, Crops, Soils, Entomology and Plant Pathology and Forest Biology. For the moment, there is little physical change in the regional laboratories, but rather a consolidation of effort and unified administrative control at each centre. This being the case, a glance at the spheres of activities of some of these laboratories is in order.

At the Vancouver laboratory, there are centralized the basic researches in Virology, as distinct from the investigation of specific virus diseases, which will continue to be studied regionally wherever the need is indicated.

* This paper presented by Dr. D. L. Bailey at the Ninth International Congress, Montreal in 1959 was of such historical significance and so well received that the executive unanimously agreed that it should be presented in condensed form in the Proceedings and be available to the membership at large.

The investigation of Cereal and Forage Crop diseases in the three Prairie provinces are handled by four laboratories located at Edmonton and Lethbridge in Alberta, Saskatoon in Saskatchewan and Winnipeg in Manitoba. A suitable division and sharing of the projects under investigation has been evolved through the years by these laboratories. A consolidation and expansion of rust investigations at Winnipeg took place relatively early, in 1926. The wisdom of this adequately supported, concerted attack soon became apparent and has continued to be justified throughout later years. Projects with which the other Prairie laboratories have been chiefly concerned have included Cereal Smuts, Take-all, Cereal Root Rots and Low Temperature Diseases of Grasses and Legumes.

Ontario is well served by four regional laboratories situated at St. Catharines, Harrow, London and Ottawa. The St. Catharines laboratory has been concerned with problems of the various tree and small fruit hosts of the Niagara Fruit Belt and has studied intensively the virus diseases of stone fruits. Harrow serves a substantial tobacco-growing industry, as well as the most intensively cultivated vegetable and truck-crop area in Canada. At the Dominion Pesticide Laboratory which is situated at London on the campus of the University of Western Ontario plant pathological investigations have been directed by Dr. R. A. Ludwig. With superb equipment and adequate staffing, including chemists, physicists, physiologists, entomologists as well as pathologists, this laboratory has been able to make wide ranging basic attacks and significant contributions in the field of toxicology. The mechanisms of fungicidal action have received close attention, while significant progress has been made in investigating the role of toxic substances in the parasitic activity of facultative parasites.

The Ottawa laboratory has been distinguished through the years as the one at which were centred the Division's mycological researches and its cryptogamic herbarium, which is the largest in Canada. In 1951, mycology was organized as a unit of this laboratory under the direction of Dr. J. W. Groves. This unit is unique, not only because of the large number of mycologists which it comprises, but also for the number, diversity and calibre of the contributions made by many of its staff. In addition to mycology, however, the laboratory also services a considerable apple-growing industry in the Ottawa and St. Lawrence river valleys; potato production in Eastern Ontario and Western Quebec; gives considerable attention to diseases of ornamental crops and has provided much of the inspection service required of imported plant propagative material under our restricted importation regulations. Its long continued investigations with respect to seed-borne diseases are unique and have amassed much significant knowledge in that field, including original studies on the bacteriophages of seed-borne bacterial plant pathogens. Until very recently also the Ottawa laboratory carried the bulk of the administrative load for the Division of Botany, under the personal supervision of the Dominion Botanists. In the recently initiated re-organization its activities will be centred for the most part in the Plant Research Institute and the Genetics and Plan Breeding Research Institute.

The laboratories at St. Jean and Ste. Anne de la Pocatière in Quebec and those in the Maritime provinces at Charlottetown, Fredericton and Kentville service mixed crops in each area. Because of the great concentration of potato production in New Brunswick and Prince Edward Island, however, the laboratories at Charlottetown and Fredericton have perforce had to concentrate on the investigation and control of potato diseases. This knowledge is important not only in local control of potato diseases but is basic to the Potato Certification scheme which, through inspection and rogueing, has functioned with signal success in building up an enviable reputation for freedom from disease of certified stock of Canadian potatoes. Potato Certification was organized by Dr. Güssow in 1914 within the Division of Botany, where it remained until 1938. At that time, with the founding of Science Service, it was transferred to a newly formed Plant Protection Division within the Production Service. In like manner the Kentville laboratory has had to deal largely with the diseases of apples as they occurred in the orchards of the Annapolis Valley. More recently special crops, especially blueberries and cranberries, have demanded attention.

This summary of our Dominion Government's plant pathological activities would be quite incomplete without some consideration of Forest Pathology. The development of Forest Pathology in Canada lagged far behind Agricultural Pathology which seems surprising, in view of the fact that forest products rank second in value only

to our Agricultural crops. However, forest resources were initially so immense that they appeared inexhaustible and any services interested in their intelligent and economical utilization had to await the spectre of their depletion. Even slower in developing was the challenge of maintaining forest yelds in perpetuity. To Mr. E. J. Zavitz, Provincial Forester for the province of Ontario, goes the distinction of having initiated forest pathological investigations in his department in 1918. In 1914 white pine blister rust was discovered in Ontario and somewhat later *Endothia* canker of chesnut made its appearance. In 1920 the first forest pathologist was appointed to the Ottawa laboratory of the Division of Botany and since then the expansion has been slow but steady. The Division of Forest Biology was founded in 1951 under the direction of the distinguished Forest Entomologist, Mr. J. J. de Gryse with an initial appropriation of the order of $1,500,000. Its headquarters were at Ottawa and it was comprised of two units, Forest Zoology, and Forest Pathology. The expansion of its scientific staff and facilities has been rapid and the sound research programme which has been initiated is impressive. Permanent research laboratories are maintained at Truro, N.S., Fredericton, N.B., Quebec City, Que., Ottawa, Maple and Sault Ste Marie, Ont., Winnipeg, Man., Indian Head and Saskatoon, Sask., Calgary, Alta., Vernon and Victoria, B.C. The laboratories at Sault Ste Marie and Maple are unique in that they were built by the Ontario Government but are equipped and staffed by the Federal Government. A broadly based programme of pathological researches now deals with disease surveys, the utilization of mature and over-mature forest stands and also with pathological problems in nurseries and young stands, as these are expressed throughout the different forest areas of Canada.

The steady advance which plant pathology has made through the years in the Dominion Dept. of Agriculture is reflected in the striking advances which have been made in the budgets supporting it. By 1959, the Science Service budget had reached the respectable total of nearly 11½ million dollars, plus an additional 2 millions for the construction and equipment of further laboratories. Of this budget the Division of Botany and Plant Pathology received $1,731,000 while Forest Biology, which includes both entomology and forest pathology, had a budget of 2½ million dollars.

In point of numbers that same year, 1959, the technical staff in Botany and Plant Pathology comprised 150 research officers. These were distributed salary-wise among five grades of positions, whose maxima ranged from $5640 to $9420. 131 of the 150 appointments were in Grades 2, 3 and 4, which range from a maximum of $6780 in Grade 2 to $8580 in Grade 4. Grade 5 positions were held chiefly by pathologists-in-charge of the plant pathology at Regional or Science Service Laboratories, while two further classes, called Chief, Research Division Grades 1 and 2, are available to persons in higher administrative positions. An upward revision of this salary range is likely to be implemented shortly and it can be counted on to reflect at least the average in Canadian Universities and other research laboratories. Starting salaries for trained personnel will be higher and Grade 5 classification is likely to be more readily attainable by individuals concerned solely with research.

With respect to the development of plant pathology under the auspices of the Provincial governments, there is little to report except in connection with their universities, which we will discuss presently. Extension, as distinct from research activties, are functions of provincial governments however and each of these has evolved an Extension programme suited to its peculiar conditions and needs. In the Ontario Dept. of Agriculture, for example, there is an Extension Branch, within which there are an Agricultural Representative service and Fruit and Vegetable Extension service. The latter service handles routine plant pathological problems and refers the more difficult ones to Regional Dominion laboratories for consultation. It also operates the Ontario Spray Calendar services, whose calendars are prepared cooperatively by the Ontario and Dominion Depts. of Agriculture.

Plant Pathology in Canadian Universities

The rapid development and present substantial proportions of plant pathology in Canada have made the providing of trained pathologists a factor of great importance. The responsibility for this has been shared largely by American and Canadian Universities. Grateful acknowledgment is due to many American institutions, but particu-

larly to the Universities of Minnesota, Wisconsin, and Cornell, for magnificent support especially in those early years when no comparable facilities were available in Canada. Gradually, however, Canadian Universities have been able to assume more of this responsibility and I would like to consider briefly the Canadian situation. In Canada, education is solely the responsibility of the provincial governments, and consequently our provincially supported universities define their matriculation requirements in terms of widely varying provincial primary and secondary school systems and plan their courses of study independently and with no strong unifying influence. Privately endowed universities and those sponsored by religious denominations have had an even freer hand with their curricula. This scheme has worked reasonably well at the undergraduate level, but has created many problems and worked some hardships for students in connection with graduate training.

The first formal course in plant pathology in Canada apparently was offered in 1905 by Prof. J. E. Howitt at the Botany Department of the Ontario Agricultural College in Guelph. For many years thereafter Professors Howitt, Stone, Sands and Evans taught plant pathology as a compulsory subject to students in Botany and several other options. In addition, they did an extraordinary amount of effective experimental and extension work in fruit, vegetable and cereal crops. Interest in pathology has been sustained in this department as it continued to develop until now it has a mycologist and four pathologists on a staff which includes as well chairs of Physiology, Ecology, Genetics, Cytology and Taxonomy. Since 1950 there has been a marked extension of its research effort and the development of graduate studies whose high standard is already recognized. Extension work is also very actively prosecuted and this includes the responsibility of operating the Spray Service for apples for the province of Ontario.

Also at the Ontario Agricultural College, but within the department of Bacteriology, bacterial diseases of plants have received special attention from its inception under Professor D. H. Jones. Much diagnostic work has been done and control measures have been studied, especially in relation to Fire Blight. This is, I believe the only Bacteriology department in Canada, which regularly teaches a course on Bacterial Diseases of Plants. Incidentally, these diseases have, in fact, been somewhat neglected. However, Dr. W. A. F. Hagborg at the Winnipeg laboratory has for many years devoted his attention to bacterial diseases of cereals and grasses and mention has already been made of the seed-borne disease investigations at the Ottawa laboratory. Fire Blight has also received attention wherever pears are grown from Ontario eastward.

In 1911, at the Macdonald Agricultural College of McGill University, Professor W. P. Fraser initiated a full year undergraduate course entitled "Plant Diseases and Fungi". This he taught until 1919, when he assumed charge of the Dominion Government cereal rust investigations in Western Canada. In 1920 at Macdonald a department of plant pathology was organized, which assumed responsibility not only for pathology but for all the botanical instruction of its agricultural students. Dr. B. T. Dickson was its chairman until 1928, and Dr. J. G. Coulson from 1929-1958. Close contact has been maintained through the years with the University Botany department which is located on the McGill campus in Montreal. An active graduate school was developed early with programs leading to the M.Sc. and Ph.D. degrees. The fields in which research has been conducted by students and staff over the years have been for a variety of reasons quite diverse, but studies of the physiology of phytopathogens and of the physiology of host-parasite relations have constituted the main line of endeavour. Out of these researches have come many significant contributions and many pathologists have been trained for university and federal services.

At the University of Toronto the initial interest in pathology was attributable to Dr. J. H. Faull and was related to diseases of forest trees. In 1918 he initiated cooperative studies with the Ontario Forestry Branch on the diseases of the balsam fir. Later, a summer field station was arranged at Lake Timagami where extensive forest pathological surveys were carried out and Dr. Faull made classic contributions to the life cycles of many rusts on coniferous species. In 1928, I joined Dr. Faull's department, but that same year he accepted a position at the Arnold Arboretum of Harvard Univesity. He was succeeded as Pofessor of Mycology by the renowned uredinologist Dr. H. S. Jackson who held the position until his death in 1951. During

that period he developed a second reputation for the studies in the Thelephoraceae carried on by himself and a large number of graduate students who majored with him in mycology. During this same period pathology also flourished at Toronto. Within the one department, not only were advanced studies in pathology and mycology offered, but supporting specialties including physiology, ecology, morphology, cytology and taxonomy were available as well. Furthermore, in other departments on the same campus a student could study a wide range of minor subjects including cytology, genetics, biochemistry, physics, bacteriology and statistics. This proved attractive to many students who had become interested in pathology at other universities, in most of which graduate courses in pathology became available only recently. Practically all students majoring in pathology have taken along with pathology, all the courses offered to mycology majors and the most commonly chosen department minor has been physiology. The majority have chosen genetics in Zoology as the second required minor subject. Many of these students have come to us on educational leave from the Dominion Government laboratories. In spite of some imperfections, this scheme has worked well, as is evidenced by the fact that a large percentage of the staff of the regional laboratories of plant pathology were thus trained and subsequently have given good accounts of themselves.

The initial staffs of the Forest pathology laboratories in Forest Biology were likewise trained at Toronto. This training was shared by mycology and pathology, the students taking most of the graduate courses of both subjects with the thesis direction shared, as seemed appropriate to the specific problems concerned. Last season the initiation of a joint appointment in Forest Pathology between Forestry and Botany paved the way for more effective direction of forest pathological researches. The establishment several years ago of a chair of Forest Pathology in the University of British Columbia offers a more specialized approach to forest pathology, in a setting eminently suited to the subject.

Graduate instruction in general pathology at the Ph.D. level is now much more widely shared by Canadian Universities than was the case for many years. Masters degrees in pathology are available in most Agricultural Colleges and in several University Botanical departments and in several of these the Ph.D. can also be obtained. The existence on several university campuses of Dominion Research Laboratories, with splendid equipment and well qualified staffs, suggests the desirability of a close cooperation with these laboratories in the training of graduate students and this will surely be forthcoming. This must, however, leave untouched the authority and the responsibility of the associated Graduate schools with respect to student training, standards, choice of problems and direction of research.

We have traced an evolution in Government sponsored plant pathological laboratories from an initial position, in which they were largely field stations, concerned essentially with ad hoc problems which were approached largely empirically and with little emphasis on basic research; through gradually shifting emphasis, until finally many of them are parts of consolidated research teams working in superbly planned, adequately serviced and beautifully equipped research centres, within which the investigation of any pathological problem can be pressed in terms as basic as the research team can underwrite.

During this same epoch, the Universities, by contrast, have done little better than hold their own. Superficially they may even have seemed to fall behind. Within them there is not to be found the same singleness of purpose and their advances have been shared among many botanical disciplines. As a simple example, greenhouse space is likely to be at a premium and it is usually not feasible to sequester large sections of this to the special environment which one pathological project may require. So now, the situation is reversed and the advanced graduate student is quite likely in the later stages of his researches to seek out and utilize facilities and special equipment he needs in a Government laboratory equipped for and interested in the investigation on which he is working. I do not feel there is anything basically unsound in this situation provided the direction of his researches is the responsibility of a specific member of the University staff and that this is not abrogated.

Graduate Schools are expensive institutions, notoriously difficult to develop and maintain at high levels of performance. It seems impossible at present to decide whether, during the next two or three decades, the training of plant pathologists

in Canada can be better served by the further development of a few graduate centres or by the development of a larger number of more specialized centres serving such phases of the field as Virology, Bacteriology, Physiology, Mycology, etc. The picture is greatly confused by the disappearance of the Division of Botany and the effect this may have on the recruitment of students into pathology. If this is made still more difficult than it has been during the past decade, the result may be tragic. It may well be that the initial recruitment into the new Botanical research units will be on the basis of a broad botanical training and that, within well-integrated groups of this sort, extremely narrow specialization will be fostered by later educational leaves. If, on the contrary, things remain much as they are, experience has developed within me a deep distrust of premature and excessive specialization in plant pathology. The abnormal is best understood in contrast with the normal and the integration of exceedingly specialized contributions into biological theory too frequently must wait on the broadly trained biologist. So, in the training of research pathologists, I believe pathology should not be divorced from mycology and physiology and all three should rest securely on an adequate foundation of general botany.

I should not like to conclude this paper without recognizing and paying tribute to our National Research Council for the substantial and effective manner in which it has assisted in developing plant pathology in Canadian Universities. Its Student and Post-doctoral Fellowships have filled great needs and helped a high percentage of our best students. Their support of university researches has likewise been farsighted, timely and generous and in the aggregate a substantial factor in the evolution of plant pathology in our universities.

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